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Mapping the hepatitis C cascade of care in people attending drug treatment services in England: a data linkage study

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Abstract

Introduction

Hepatitis C (HCV) infection in England primarily affects people who inject drugs (PWID). We describe persons HCV tested, estimate incidence and establish the cascade of care (CoC) for people engaging with drug services.

Methods

Persons testing for HCV in drug services in Sentinel Surveillance of Blood Borne Virus Testing (SSBBV) between 2008 and 2016 were linked with people attending drug services in the National Drug and Treatment Monitoring System (NDTMS). We describe risk characteristics, establish the CoC, and estimate HCV incidence in PWID diagnosed in drug services.

Results

Of 46,721 persons tested for anti-HCV in SSBBV in drug services, 29,773 (63.7%) linked to NDTMS. Of these, 9,100 (30.6%) were anti-HCV positive and anti-HCV positivity was 45.0% in persons reporting urgent housing problems and 43.8% in persons reporting ever injecting. Among persons anti-HCV positive, half had ≥1 positive anti-HCV test. For persons' first anti-HCV positive between 2008 and 2013 (n=3123), 74.9% were HCV RNA tested, of whom 71.2% were RNA positive, and of these, 14.0% had evidence of interferon-based treatment, with 52.8% achieving cure. Among PWID, HCV incidence was 8.7 per 100 person-years (95% CI: 8.1-9.2).

Conclusion

Through record linkage of surveillance datasets, we estimated the HCV CoC for people attending drug services, providing a benchmark from which to monitor the impact of strategies to scale-up prevention, testing, and curative treatment with direct acting antivirals. Our study highlights wasteful repeated testing and poor linkage to care for this high risk population which need to be addressed.

Introduction

In 2018, an estimated 113,000 persons were chronically infected with hepatitis C (HCV) in England [1]. These persons are at increased risk of liver cirrhosis, end-stage liver disease (ESLD) and hepatocellular carcinoma (HCC). Most HCV infections in the UK are among persons who inject drugs (PWID), whether currently, or in the past [2]. Accordingly, for the UK to achieve the goal of eliminating HCV as a major public health threat, improvements in HCV prevention and treatment in PWID are essential. In 2014, direct acting antivirals (DAA) were introduced free of charge to patients in England, initially to those with severe liver disease through an expanded access programme, before becoming the NHS standard of care from 2015 onwards. DAAs are of shorter treatment duration, better tolerated and more effective than previous interferon-based regimens[3].

Using Sentinel Surveillance of Blood Borne Virus Testing (SSBBV), which collects information on all tests regardless of result from collaborating laboratories across England, Simmons et al. (2018) estimated the HCV cascade of care (CoC) in the pre-DAA era[4]. An estimated 10.4% of persons testing HCV RNA positive within drug services between 2008 and 2014 received treatment with ribavirin and pegylated interferon, compared to 21.4% among persons diagnosed in any setting and 29.4% in those diagnosed in general practice. This difference likely reflects the social exclusion and poorer access to care experienced by PWID [5]. However, SSBBV has limited demographic, risk factor (eg injecting status and missing in 70% of records) and service utilisation information, making it difficult to characterise the PWID population, and identify bottlenecks in their care pathway.

Data on persons attending drug services for problematic drug and alcohol use in England are reported to the National Drug Treatment Monitoring System (NDTMS), and indicate that 65.7% of people eligible [6] (ever injected drugs) self-reported being HCV tested, 81.5%

among person with evidence of injecting drug use (IDU) [7]. However, data on HCV positivity, linkage to care and outcome from HCV treatment in this population is limited.

Linkage between the two surveillance systems provides an opportunity to better understand people who are tested, and positive, for HCV in specialist drug services, their associated risk factors and HCV treatment outcomes. Of particular importance is describing the CoC from diagnosis to treatment outcome, so that we can improve, and provide more detail on, the pre-DAA baseline CoC estimates gained from Simmons et al in this vulnerable population, with additional information held by NDTMS.

Methods

Data sources

Public Health England's (PHE) SSBBV testing collects information on hepatitis A-E, HIV and HTLV positive and negative tests, patient demographics and the service requesting the tests, from 23 participating sentinel laboratories in England [8]. Data from the participating laboratory information systems are extracted and records of individuals are deduplicated and linked to all other test results using a combination of Soundex (phonetic algorithm for indexing names), date of birth, NHS number and hospital number. Limited risk factor information is available.

PHE's NDTMS collects data on treatment delivery for problematic drug and alcohol use, through community-based, outpatient and inpatient settings, in England, covering all publically funded treatment (approximately 900 sites in 2017). Specialist drug services provide demographic and clinical information on persons receiving treatment for drug and alcohol addiction, the interventions delivered to them and outcomes. NDTMS does not collect information on persons who use drug and alcohol services but are not being treated for their addiction,e.g. needle and syringe programmes (NSP).

Data Linkage

Personal identifiers within NDTMS are limited, but include initials, date of birth, sex, and drug and alcohol action team (DAT) of residence and treatment. DATs are multiagency partnerships responsible for coordinating local initiatives and programs on drug and alcohol use. All persons (1,095,944 as of December 2017) in NDTMS are required to have these identifiers, and were matched to persons in SSBBV who were tested in drug services and had the corresponding information (initials, date of birth, sex and location of test as minimum).

As there were no additional variables available to identify the correct match, only one-to-one matches were accepted; where more than one NDTMS client matched to the same SSBBV persons, none were retained.

For linked persons, all anti-HCV and HCV RNA testing data (including testing outside of drug services) were extracted from SSBBV. Patient demographics, risk factors and drug history were extracted from NDTMS. Persons anti-HCV tested in drug services in SSBBV between 2008 and 2016 were included in analysis. History of injecting drug use was assigned based on information from SSBBV and/or NDTMS. The drugs used by persons were classified according to a hierarchy, with opiates being recorded over non-opiate drug use and co-addiction with alcohol being recorded over no problems with alcohol.

Cascade of care

SSBBV allows an estimation of the CoC, where sequential HCV RNA tests during a 390-day period, indicative of treatment monitoring, are used to identify persons who received treatment with ribavirin and pegylated interferon, with a final negative PCR indicative of viral clearance. This methodology has been validated against a clinical database and used by Simmons et al. (2018) [4,9].

We estimated interferon-based treatment rates for persons first diagnosed between 2008 and 2013 in drug services, the years during which treatment could be monitored using the SSBBV sequential PCR algorithm, and treated up to end-2014, after which DAAs became the most common treatment regimen. The CoC was estimated for persons with a history of injecting drug use, opiate use (with and without alcohol misuse), urgent housing problems and multiple positive anti-HCV tests in drug services and compared.

Statistical Analysis

Statistical analysis was carried out in STATA SE (version 15), with Chi-squared test being used to compare categorical variables and Wilcoxon rank-sum tests to compare continuous variables.

Using logistic regression models, we examined predictors of testing positive for HCV, regardless of setting of positive test, between 2008 and 2016, using the following variables: age, sex, ethnicity, drug type, alcohol use, history of injecting drug use, and housing status. Only variables found to be significant ($p < 0.05$) were included within the final model. Two-way interactions were examined.

Overall (2008-2016 inclusive) and three-year rolling incidence of HCV was calculated for all persons, and persons with a history of injecting drug use, who had at least two anti-HCV tests within each three-year period, regardless of location of tests, between 2008 and 2016 in SSBBV. For persons with two negative test results, their two most recent negative tests were used to calculate follow-up time in person-years; for persons who tested positive, follow-up time in person-years was calculated from their last negative test date till their first positive test date . When estimating incidence by age group, age was based on the first negative test used to calculate follow-up time. 95% confidence intervals were calculated using the Poisson distribution.

Results

Between 2008 and 2016, 46,721 persons in SSBBV were identified as having had anti-HCV testing in drug services. Median age at test was 36 years (Interquartile range (IQR): 30-42 years), and 70.5% (32,961) were male. Of those, 12,249 (26.2%) were anti-HCV positive, and 7,171 (58.5%) were RNA positive during this period. Complete identifiers were available for 87.5% (40,921), of which 72.8% (29,773) linked to NDTMS. There was little difference between persons who did and did not link to NDTMS by sex and age, however a lower proportion of records were linked among those 14-29 years and 50 years and older, compared with other age groups (see supplementary table 1).

Characteristics of linked persons tested for HCV in drug services

Of linked persons (29,773), the median age at HCV test was 36 years (IQR: 30-42 years), with men accounting for 72.1% and 66.0% reporting having ever injected drugs (table 1). At least one drug treatment episode starting between 2008 and 2016 was reported for 28,597 (96.1%) , with a median of 3 (IQR: 2-5) treatments over the period. The remaining 1,176, were treated outside the 2008-2016 study period.

Anti-HCV positivity was 30.6% (9,100) over the period (table 1), 95.3% (8,668) of whom tested positive within drug services in SSBBV, with the remainder mostly tested in general practice (123) or prison services (81). The median age at first positive HCV test was 38 years (IQR: 32-44 years), and positivity was highest among persons who reported an urgent housing problem (45.0%), who had ever injected drugs (43.8%) and reported ever having a problem with opiates and alcohol (42.5%).

Among those anti-HCV positive (9,100), 7,036 had a HCV RNA test in SSBBV between 2008 and 2016, with a further 333 being tested outside this period. The majority (4,936) had

two or more HCV RNA test between 2008 and 2016 (median: 2; IQR: 1-4). Over the period, 5,208 (74.0%) were positive at any stage and 3,927 (55.8%) were positive on their last HCV RNA test.

Among persons with no reported IDU, 4.7% (n=478) were anti-HCV positive. When compared to persons with IDU reported, a higher proportion were female, (36.0% vs 28.0; p<0.001), and persons were older at first diagnosis (regardless of setting) (40 years vs 36 years, p<0.001). However, 80.5% (n=385) reported history of opiate use. Where route of drug use was known (452), only 17 persons reported having snorted drugs.

Cascade of Care for HCV

Of linked persons, 16,707 were tested for anti-HCV in drug services between 2008 and 2013, the years the treatment algorithm can monitor pre-DAA treatment, and 3,123 were diagnosed as HCV positive for the first time. By 2014, 2,340 (74.9%) were HCV RNA tested, 1,666 (53.3%) were HCV RNA positive, 233 (7.5%) were treated, and 123 (3.9%) achieved SVR (Figure 1). Similar treatment rates were observed for persons who had ever injected drugs, misused opiates only, misused opiates and alcohol and who had urgent housing problems (supplementary table 2). However, a higher proportion of persons were treated when there was a record of multiple positive tests in drug services (11.9%).

Predictors of anti-HCV positivity

Persons had higher odds of ever testing positive (in any setting) for anti-HCV with increasing age (per 10 year increase in age: adjusted odds ratio (aOR): 1.59; 95% confidence interval (CI): 1.53-1.65), female sex (aOR: 1.32; 95% CI:1.23-1.41), ever injected drugs (aOR: 10.64; 95% CI: 9.43-12.01), a housing problem reported (housing problem: aOR: 1.12; 95% CI: 1.04-1.21; urgent housing problem: aOR: 1.82; 95% CI: 1.68-1.97), reported opiate misuse

(aOR: 3.95; 95% CI: 3.18-4.91) and reported alcohol misuse (aOR: 1.09; 95% CI: 1.03-1.16) (table 2). Persons had lower odds of testing positive if they were Asian (aOR: 0.34; 95% CI: 0.27-0.43) or black (aOR: 0.77; 95% CI: 0.61-0.97) when compared to persons of white ethnicity.

Multiple HCV testing

Between 2008 and 2016, 23.8% (7,072/29,773) persons tested had more than one anti-HCV test within drug services (regardless of result), with an average of 1.4 tests per person, equating to 40,245 anti-HCV tests reported to SSBBV (range: 1-13). The positivity of these tests was 29.5% (11,884).

Among those anti-HCV positive, half (50.8%, n=4625) had more than one positive HCV test reported to SSBBV from any setting between 2008 and 2016 (median 2.0 tests per person), and 2288 persons had more than one positive test result within drug services. An additional positive test prior to this period (2002 (start of SSBBV) and 2007) was reported to SSBBV for 1,593 (18.4%) persons, of which 26.7% had their first positive HCV test in drug services, 21.0% in general practice and 11.9% in prison.

HCV Incidence

Among persons anti-HCV negative between 2008 and 2016 (21,765), 8,452 had more than one HCV test conducted during this period, a median of 1.6 years (IQR: 0.8-3.0 years) apart. Of persons with two tests, 14.0% (1,092) subsequently tested anti-HCV positive, equivalent to an estimated anti-HCV incidence of 6.3 per 100 person years (95% CI: 5.9-6.7). For persons with a history of injecting drug use (n=5,801) the estimated incidence was 8.7 per 100 person years (95% CI: 8.1-9.2) and was 11.9 per 100 person years (95% CI: 10.7-13.1) in persons who reported urgent housing problems. Incidence was lower in older age groups; 8.4

per 100 person years (95% CI: 7.6-9.2) in persons aged 14-29, 6.0 per 100 person years (95% CI: 5.4-6.5) in persons 30-39 years, 5.0 per 100 person years (95% CI: 4.3-5.8) in persons 40-49 and 2.8 per 100 person years (95% CI: 1.7-4.1) in persons 50 years and older. Three-year rolling incidence rates in persons who have ever injected drugs are presented in figure 2, with an average three-year rolling incidence of 9.3 per 100 person years.

Discussion

Main findings

Between 2008 and 2016, 31% of persons tested in drug services and reported to SSBBV were anti-HCV positive; 95.3% were first reported anti-HCV positive through drug services and 4.7% in other services. Persons diagnosed positive were more likely to be female and have reported injecting drug use, opiate use, alcohol use, and housing problems. Half of persons anti-HCV positive had multiple positive test results reported to SSBBV, on average 2.0 per person, 18% had been diagnosed with HCV prior to 2008. HCV treatment with ribavirin and pegylated interferon between 2008 and 2013 was low, at 14.0% of persons HCV RNA positive. HCV incidence was estimated to be 8.7 per 100 person years in people who report IDU.

Limitations

For the first time we linked SSBBV and NDTMS, two routinely collected surveillance datasets, providing a large sample of persons attending drug services for analysis. SSBBV covers approximately 40% of all HCV testing, providing representative data to monitor HCV infection and the cascade of care of diagnosed persons, and NDTMS has enriched testing data with demographic and risk characteristics of the PWID population. The low matching rate (64% of SSBBV drug tests) with NDTMS may partly be explained by PWID who use NSP and are tested for HCV, but have never initiated treatment (and so not included in NDTMS) and the strict matching criteria that was required. We do not know how linked and unlinked persons differ but demographics for opiate users in our linked data and annual NDTMS reports are similar [10]. In addition, positivity rates for PWID are similar in our linked data and the Unlinked Anonymous (UAM) Survey of people in contact with drug services [11].

Further, since 2014 some testing at drug clinics will be missed if persons were only tested with dried blood spot (DBS) testing and processed by commercial laboratories who have inconsistently reported to SSBBV. NDTMS does not collect information on PWID who use NSP but have never accessed treatment for their drug or alcohol problems. How they differ from our cohort in unknown but they are more likely to contain recent injecting initiates, active injectors and injectors with more chaotic lifestyles, who are at increased risk of acquiring and transmitting HCV [12]. This could explain why fewer persons aged 14-29 years in SSBBV were linked. Monitoring incidence and re-infection in this actively injecting population through improved data collection and surveillance systems is therefore important. Additionally, while the treatment monitoring algorithm is highly specific and sensitive at detecting treatment, estimates may be an underestimate if the testing to monitor treatment was processed by laboratories outside the SSBBV network.

Other evidence and implications

With the enhanced information provided through linkage with NDTMS, we were able to look at the CoC in sub-sets of the HCV diagnosed population attending drug services and provide stronger evidence of the CoC estimates for this population by Simmons et al. (2018)[4]. While we were unable to look at CoC stage prior to anti-HCV testing (the proportion of at risk persons in drug treatment), NDTMS data suggests testing rates of eligible PWID in drug treatment have improved over recent years, increasing from 57% of persons receiving an HCV test in 2009-10 to 83% in 2015-16[13].

The low treatment rates estimated through the CoC are sub-optimal for this population, and lower than Simmons et al. found in all HCV diagnosed persons overall (21.4%), reflecting the inequalities experienced by this vulnerable population. While annual testing in drug services may be recommended by NICE, our findings show multiple positive anti-HCV tests

(median: 2), both within and outside drug services, with suboptimal translation into treatment. It is important to note that although treatment uptake was low regardless of the number of positive tests, there was a higher proportion treated among those with multiple positive tests. This indicates a problem in confirmatory testing and subsequent engagement in care, rather than simply in the identification of anti-HCV positive persons, and represents inefficiencies in the diagnosis to treatment pathway. It is likely that due to limited DBS testing coverage in SSBBV, we are underestimating the amount of repeat positive anti-HCV testing. Challenges in linkage to care have also been observed in emergency department testing initiatives, where Parry et al. [14] found it 6 times more difficult to engage HCV diagnosed persons in care than persons diagnosed with hepatitis B or HIV. Our study reinforces recommendations for services to be patient focused, community-based and as close to a single-step pathway as possible. It is anticipated that the introduction of DAAs and the pressure on lead clinicians in hospitals to meet NHS England treatment targets ("run rates"), as well as the need to treat active PWIDs in order to achieve WHO elimination targets, will help reduce the system and structural barriers to treatment [15]. Coverage of opiate substitute therapy (OST) and NSP still needs to be maintained, as modelling has suggested that OST and high coverage of NSP can reduce HCV acquisition risk by 50% and 76% respectively in Europe [16].

We found predictors of a positive anti-HCV test at any time in the study period included being female, increasing age, ever injecting drugs, opiate use, alcohol misuse and housing problems. This corroborates the findings of similar studies, with positivity associated with female sex, identified risk behaviours associated with HCV infection being more frequently reported in women, including pooling with others to buy drugs, heroin use and reusing and sharing drug taking paraphernalia (including cookers and syringes) [17–19]. Furthermore, the UAM survey in England has consistently found higher reported rates of sharing needles and

syringes in females [20]. Anti-HCV positivity was also associated with housing problems; which have been associated with higher rates of risk behaviours, such as public injecting and sharing of injecting equipment, in UAM data [21], along with other studies [22–24]. Were we able to adjust for these risk behaviours the observed difference by gender and housing status may have been diminished.

Whilst the majority of persons HCV positive had a documented injecting history (95%), there was a substantial amount of testing in persons not reporting injecting (34%), with associated anti-HCV positivity at 4.7%. This is double that found in opt-out emergency department testing studies, which are being evaluated as a way of identifying undiagnosed persons [14,25]. It is possible that these persons did not disclose or recognise previous IDU; alternatively, other risk factors, such as blood transfusion, sexual transmission, sharing paraphernalia used to snort drugs, tattooing or needlestick injuries may have contributed to their HCV status. The substantial proportion of anti-HCV positive individuals in non-injectors suggests that routine HCV testing of all drug service attendees may be of value in identifying persons who might not otherwise be diagnosed with HCV.

Previous estimates of HCV incidence for persons attending drug services and PWID have varied quite widely, and a literature review by Wiessing et al. [26] found UK estimates to be between 2.7 and 42 HCV infections per 100 person years (mean: 14), likely reflecting not only the heterogeneity of risk (by demographic and risk factors) in PWID, but also the methodological challenges in assessing incidence in this population and setting. More recently, Hope et al. [27] estimated incidence to be 12.3 per 100 person years using data from the 2011-2013 UAM surveys. Through record linkage, we have estimated incidence at 8.7 per 100 person years in PWID between 2008 and 2016, slightly lower than the mean in Wiessing et al and Hope et al. In the future, with improved coverage of DBS testing, data linkage could

provide an alternative approach through which to estimate HCV incidence in PWID- and important metric for measuring progress towards the WHO elimination goal.

Conclusion

By linking routinely collected surveillance data on HCV testing and people attending specialist drug services, we found that problem drug users are frequently tested but the linkage to HCV treatment and care is poor. Our study established a baseline HCV treatment-rate for interferon-based therapies in persons receiving treatment for drug addiction. Worryingly, overall treatment uptake is suboptimal among this population, with evidence of treatment where multiple positive HCV tests had occurred. Drug services need to provide community-based, patient-focused, streamlined testing and treatment pathways, to reduce the health inequalities experienced by drug service users, particularly those more vulnerable, such as women and homeless persons. Robust monitoring of the CoC using data linkage approaches should continue to ensure that PWID have equitable access to DAAs in appropriate settings.

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Table 1: Characteristics of persons linked to NDTMS and tested for anti-HCV between 2008 and 2016 in drug services in England. Positivity is presented for tests within drug services only (within parentheses) and where positive in any setting in SSBBV.

	Number tested	anti-HCV positive in any setting	
		N *(in drug service)*	percent *(in drug services)*
Total	29,773	9,100 *(8,668)*	30.6 *(29.1)*
Sex			
Male	21,471	6,514 *(6,223)*	30.3 *(29.0)*
Female	8,302	2,586 *(2,445)*	31.1 *(29.5)*
Age [$]			
14-29 years	7,024	1,430 *(1,287)*	20.4 *(18.3)*
30-39 years	12,310	3,877 *(3,689)*	31.5 *(30.0)*
40-49 years	8,082	2991 *(2,906)*	37.0 *(36.0)*
50+ years	2,356	802 *(786)*	34.0 *(33.3)*
Ethnicity			
White	25,538	8,153 *(7,771)*	31.9 *(30.4)*
Black	650	130 *(125)*	20.0 *(19.2)*
Asian	1,114	95 *(93)*	8.5 *(8.3)*
Other	949	272 *(253)*	28.7 *(26.7)*
Not reported	1,522	450 *(426)*	29.6 *(28.0)*
Nationality			
British	26,946	8,300 *(7,891)*	30.8 *(29.3)*
European	697	276 *(273)*	39.6 *(39.2)*
Other	560	106 *(102)*	18.9 *(18.2)*
Not reported	1,570	418 *(402)*	26.6 *(25.6)*
Drug			
Opiate plus Alcohol	8,449	3,593 *(3,405)*	42.5 *(40.3)*
Opiate	13,989	5,184 *(4,960)*	37.1 *(35.5)*
Non-opiate plus Alcohol	3,039	127 *(119)*	4.2 *(3.9)*
Non-opiate only	1,466	74 *(68)*	5.0 *(4.6)*
Alcohol only	2,830	122 *(116)*	4.3 *(4.1)*
Ever Injected			
Yes	19,664	8,622 *(8,221)*	43.8 *(41.8)*
No	10,109	478 *(447)*	4.7 *(4.4)*
*Housing status**			
Urgent housing problem[1]	4,947	2,228 *(2,085)*	45.0 *(42.1)*
Housing problem[2]	6,305	1,997 *(1,904)*	31.7 *(30.2)*
No housing problem	16,935	4,308 *(4,134)*	25.4 *(24.4)*
Not reported	1,586	567 *(545)*	35.8 *(34.4)*
*Sexuality^*			
Heterosexual	9,675	2,948 *(2,808)*	30.5 *(29.0)*
Homosexual	155	34 *(32)*	21.9 *(20.6)*
Other	181	53 *(50)*	29.3 *(27.6)*
Not Reported	19,762	6,065 *(5,778)*	30.7 *(29.2)*
Region [$]			
East Midlands	906	216 *(197)*	23.8 *(21.7)*
London	3,671	932 *(903)*	25.4 *(24.6)*
North East	4,404	925 *(849)*	21.0 *(19.3)*
North West	7,771	3,357 *(3,235)*	43.2 *(41.6)*
South East	1,435	372 *(340)*	25.9 *(23.7)*
South West	2,818	798 *(752)*	28.3 *(26.7)*
West Midlands	1,683	450 *(440)*	26.7 *(26.1)*
Yorkshire and Humber	7,085	2,050 *(1,952)*	28.9 *(27.5)*
Treated for alcohol or drug misuse between 2008-2016			
Yes	28,597	8,623 *(8,211)*	30.2 *(28.7)*
No	1,176	477 *(457)*	40.6 *(38.9)*

$ at time of first anti-HCV test between 2008-2016; £ vaccinated up to end 2016; * worst housing status between 2008 and 2016; ^ collected from 2016; [1] Lives on the streets, used night hostels or sleeps on different friends floor each night; [2] short term guest with friends/family, uses night winter shelter, direct access short stary hostel or short term B&B.

Table 2: Multivariable logistic regression to examine factors associated with ever testing positive for anti-HCV (in any setting) for persons linked between SSBBV and NDTMS.

	adjusted odds ratio	95% confidence interval	p-value
Sex			
Male	1		<0.001
Female	1.32	1.23-1.41	
Ethnicity			
White	1		
Asian	0.34	0.27-0.43	<0.001
Black	0.77	0.61-0.97	
Other	1.03	0.87-1.22	
Age^			
per 10 year increase	1.59	1.53-1.65	<0.001
Ever injected drugs			
No	1		<0.001
Yes	10.64	9.43-12.01	
*Drug misused**			
None reported	1		
Non-opiate	0.76	0.59-0.99	<0.001
Opiate	3.95	3.18-4.91	
Alcohol misuse			
No	1		
Yes	1.09	1.03-1.16	0.005
Housing status£			
No housing problem	1		
Housing problem	1.12	1.04-1.21	<0.001
Urgent housing problem	1.82	1.68-1.97	

*exclusive groups where opiate misuse categorised over non-opiate misuse; ^age at first test between 2008 and 2016; £ worst housing status between 2008 and 2016

Figure 1: The cascade of care, in the era of ribavirin and pegylated interferon treatment, for persons tested for anti-HCV in drug services between 2008 and 2013, followed up to 2014, and linked to NDTMS in England

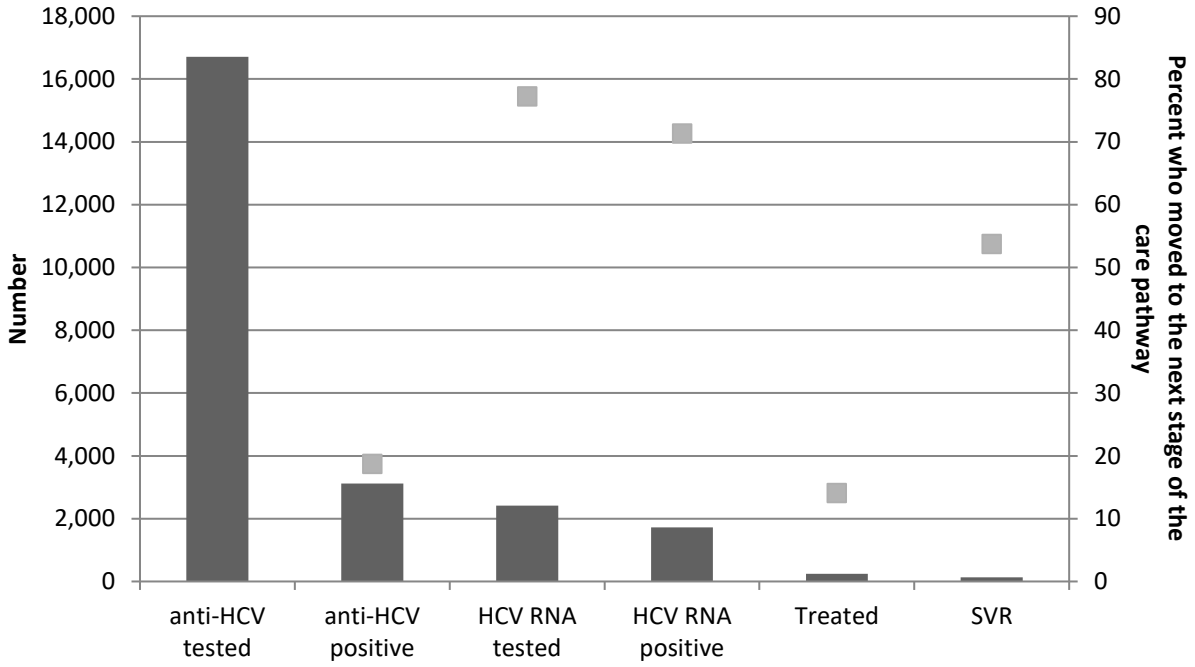

Figure 2: Three-year rolling incidence of anti-HCV in persons who have ever injected drugs